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THE WORK OF THE HUNTLEY RECLAMATION PROJECT EXPERIMENT FARM IN 1916.¹

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INTRODUCTION.

The work carried on at the Huntley Experiment Farm relates chiefly to the production and utilization of crops under irrigation. A part of the farm lying above the main irrigation canal is used for experiments in dry-land agriculture, including crop rotation, tillage methods, and pasturing tests. The experiments with irrigated crops in 1916 were principally a continuation of those started in previous seasons and included crop rotations, tests of pasture grasses, cropping methods, and varieties of field crops, experiments with sugar beets, and tests of fruit trees and small fruits. A diagram of the land used is shown in figure 1.

The principal additions to the investigational work in 1916 were made for the purpose of securing information needed by irrigation farmers in connection with the establishment of live-stock industries. The new experiments included tests of several methods of establishing irrigated pastures, some additional work in pasture utilization, and methods of seeding clover. Some additional crop-rotation experiments were also inaugurated. This report deals with the experiments with irrigated crops and discusses the principal results accomplished in 1916.

¹ The Huntley Experiment Farm is located on the Huntley Reclamation Project, near the town site of Osborn, Mont. It comprises about 270 acres of public land, of which about 140 acres lie above the irrigation canal. In addition, a tract of 40 acres of the heavy land near the town of Worden is used for experiments in reclaiming alkali soils. The work of the farm is under the supervision of the Office of Western Irrigation Agriculture. The Office of Dry-Land Agriculture and other offices in the Bureau of Plant Industry and the Montana Agricultural Experiment Station are cooperating in the investigational work.

CONDITIONS ON THE PROJECT.

CLIMATIC CONDITIONS.

The rainfall at the Huntley Experiment Farm was slightly below normal in 1916 and was especially light during the growing season. The frost-free period was 119 days, while the average for the past six years was 127 days. The first frost in the fall occurred on September 13.

A summary of the climatological observations made during the past six years is given in Table I.

TABLE I.—Summary of climatological observations made at the Huntley Experiment Farm, 1911 to 1916, inclusive.

PRECIPITATION (INCHES).													
Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1911.....	0.64	0.32	0	0.85	3.29	2.13	0.81	1.05	0.57	0.88	0.82	0.13	11.49
1912.....	.27	.21	.41	2.00	2.44	1.14	2.25	1.39	2.97	3.25	.75	0	17.08
1913.....	.29	.10	.40	.43	1.27	2.20	1.10	1.19	1.43	2.89	.45	.17	11.92
1914.....	.11	.19	.52	1.16	2.93	3.31	.05	.76	1.90	1.07	.07	.24	12.21
1915.....	.41	.02	.78	.23	2.50	5.99	3.11	.50	1.64	.31	1.34	.71	17.54
1916.....	.46	.24	1.02	.89	1.81	2.11	1.50	.39	1.16	1.34	1.07	1.50	13.49
Average.....	.36	.18	.52	.93	2.37	2.81	1.47	.88	1.61	1.62	.75	.46	13.96

EVAPORATION (INCHES).													
1911.....	.....	.....	.....	4.388	5.827	7.124	8.875	6.071	5.079	2.568	.....	.....	39.932
1912.....	.....	.....	.....	.....	4.930	7.020	6.942	6.950	3.722	2.475	.....	.....	32.018
1913.....	.....	.....	.....	.....	4.330	5.080	7.020	6.300	4.450	.....	.....	.....	28.050
1914.....	.....	.....	.....	.....	2.770	4.330	4.935	7.778	7.216	4.284	.....	.....	31.320
1915.....	.....	.....	.....	.....	4.170	4.334	4.582	5.493	6.018	3.348	.....	.....	27.915
1916.....	.....	.....	.....	.....	3.338	4.432	5.389	8.670	7.320	5.031	.....	.....	34.180
Average.....	.....	.....	.....	.....	3.659	4.687	5.838	7.463	6.646	4.324	2.522	.....	32.236

DAILY WIND VELOCITY (MILES PER HOUR).													
Average:	.....	.....	.....	.....	5.6	5.6	4.5	4.6	4.4	4.4	4.2	5.4	5.5.....
1911.....	.....	.....	.....	.....	5.6	5.6	4.5	4.6	4.4	4.4	4.2	5.4	5.5.....
1912.....	5.6	5.2	4.8	5.8	6.3	5.2	3.9	3.7	4.2	5.6	4.2	7.8	.....
1913.....	6.3	5.9	5.2	6.3	4.5	3.8	3.7	3.2	3.6	4.0	.....	.....	.....
1914.....	.....	.....	5.3	5.1	4.0	3.2	2.7	3.2	3.5	2.5	3.5	2.5	.....
1915.....	3.4	2.8	3.7	4.2	5.0	3.9	3.1	2.3	3.4	3.7	3.9	3.6	.....
1916.....	5.2	4.6	5.2	4.7	5.9	4.9	3.8	3.4	4.0	4.4	6.6	5.9	.....
Maximum:	.....	.....	.....	.....	9.4	8.8	8.8	8.7	7.2	9.3	10.0	11.6	11.5.....
1911.....	.....	.....	.....	.....	13.0	17.5	7.7	6.0	6.5	8.0	14.7	9.7	14.6.....
1912.....	12.8	10.8	12.1	10.1	9.2	5.4	8.6	5.7	8.8	8.3	.....	.....	.....
1913.....	11.9	12.6	10.5	10.1	8.5	6.7	5.6	6.4	9.6	5.6	6.4	8.1	.....
1914.....	.....	.....	.....	.....	16.2	6.1	6.6	4.5	8.4	9.0	10.6	8.4	.....
1915.....	7.3	5.8	8.4	10.0	16.2	6.1	6.6	4.5	8.4	9.0	10.6	8.4	.....
1916.....	15.3	10.0	13.3	8.0	11.9	10.2	8.4	7.3	9.9	9.7	17.3	16.5	.....
Minimum:	.....	.....	.....	.....	2.0	1.5	2.7	2.3	2.1	1.0	1.3	1.4	1.5.....
1911.....	.....	.....	.....	.....	2.0	1.5	2.7	2.3	2.1	1.0	1.3	1.4	1.5.....
1912.....	.7	1.6	.9	2.6	1.8	2.3	.6	.8	.9	1.5	1.0	2.7	.....
1913.....	1.0	1.7	1.9	1.0	.9	1.3	2.1	.8	.4	1.5	.....	.....	.....
1914.....	.....	.....	1.6	2.1	1.7	1.6	.3	1.4	1.3	1.1	.8	.6	.....
1915.....	.3	.8	.8	2.2	1.1	2.1	1.1	.4	1.0	1.2	1.2	1.0	.....
1916.....	1.0	.9	1.5	2.9	2.7	1.5	1.9	.3	.9	1.8	.8	.4	.....

TABLE 1.—*Summary of climatological observations made at the Huntley Experiment Farm, 1911 to 1915, inclusive—Continued.*

MONTHLY TEMPERATURE (°F.).

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Mean:													
1911.....	14.2	16.1	39.1	43.2	53.8	68.5	67.6	64.1	58.2	44.8	24.9	13.6	.....
1912.....	16.6	29.1	18.7	46.5	55.5	66.8	67.2	66.6	50.1	44.7	38.7	29.7	.....
1913.....	14.0	17.7	24.0	46.4	55.0	65.9	68.0	70.0	57.3	41.0	38.2	30.6	.....
1914.....	27.0	19.0	26.0	45.0	56.0	63.0	75.0	68.0	58.0	48.0	39.0	15.0	.....
1915.....	19.0	26.0	33.0	54.0	53.0	59.0	65.0	69.0	52.0	48.0	30.0	23.0	.....
1916.....	4.0	24.0	39.0	45.0	51.0	62.0	73.0	68.0	56.0	42.0	32.0	14.0	.....
Maximum:													
1911.....	50.0	40.0	74.0	77.0	92.0	94.0	97.0	97.5	94.0	84.5	55.0	55.0	.....
1912.....	53.0	52.0	62.0	78.0	90.0	99.5	95.0	93.0	89.0	79.0	69.0	59.0	.....
1913.....	56.0	63.0	61.0	82.0	89.0	98.0	98.0	97.0	94.0	81.0	67.0	55.0	.....
1914.....	58.0	54.0	68.0	75.0	83.0	93.0	100.0	99.0	89.0	80.0	69.0	48.0	.....
1915.....	52.0	54.0	66.0	86.0	82.0	87.0	94.0	97.0	89.0	80.0	71.0	42.0	.....
1916.....	52.0	60.0	74.0	87.0	90.0	91.0	100.0	97.0	94.0	78.0	68.0	58.0	.....
Minimum:													
1911.....	-26.0	-19.0	- 3.0	17.0	24.0	40.0	41.0	33.5	28.0	14.0	-20.5	-26.0	.....
1912.....	-35.0	- 5.0	-27.0	20.0	32.0	36.0	44.0	40.0	24.0	17.0	13.0	1.0	.....
1913.....	-32.0	-21.0	-25.0	20.0	31.0	42.0	43.0	44.0	29.0	20.0	14.0	- 5.0	.....
1914.....	- 6.0	-38.0	- 3.0	17.0	22.0	36.0	44.0	38.0	33.0	24.0	- 3.0	-23.0	.....
1915.....	-28.0	- 4.0	11.0	25.0	28.0	36.0	41.0	43.0	32.0	20.0	5.0	-13.0	.....
1916.....	-39.0	-20.0	- 5.0	19.0	23.0	36.0	45.0	44.0	26.0	13.0	-13.0	-22.0	.....

KILLING FROSTS.

Year.	Last in spring.		First in autumn.		Frost-free period.
	Date.	Minimum temperature.	Date.	Minimum temperature.	
1911.....	May 26	° F. 32	Sept. 18	° F. 28	Days. 114
1912.....	May 13	28	Sept. 16	31	125
1913.....	May 5	31	Sept. 19	29	136
1914.....	May 12	32	Oct. 6	31	146
1915.....	May 21	32	Sept. 19	32	120
1916.....	May 16	30	Sept. 13	31	119

CROP CONDITIONS.

The season of 1916 was, perhaps, slightly below the average with respect to the yields of most crops. The growing season was somewhat shorter than usual, and the seasonal rainfall was below normal. On parts of the project, crops were damaged to some extent by hail and in some cases grain crops were totally destroyed. The sugar-beet crop was below the average, both in tonnage and sugar content, and was late in maturing, so that some difficulty was experienced in harvesting because of stormy weather and severe freezing.

The acreage, yields, and farm values of the crops produced in 1916 are given in Table II, which was compiled from data furnished by the United States Reclamation Service.

The total area from which crops were harvested on the 553 farms in operation on the project in 1916 was 18,581 acres, as compared with 18,203 acres in 1915. The acreage in sugar beets in 1916 was 5,264, which was 138 acres less than the sugar-beet acreage of the previous year. The acreage of alfalfa increased from 5,287 in 1915

to 5,422 in 1916. Most of the remaining acreage was devoted to cereals, chiefly wheat and oats, each of which occupied about 2,600 acres. In 1916 the average yields of beets, alfalfa, oats, and wheat were lower than in 1915, and the average farm value per acre of all crops was \$26.32, as compared with \$29.41.

TABLE II.—*Acreage, yields, and farm values of crops produced on the Huntley Reclamation Project in 1916.*

Crop.	Area (acres).	Unit of yield.	Yields.			Farm values.		
			Total.	Per acre.		Per unit of yield.	Total.	Per acre.
				Average.	Maxi- mum.			
Alfalfa hay.....	5,422	Ton.....	14,411	2.66	6.0	\$8.95	\$129,263	\$23.84
Alfalfa seed.....	23	Bushel.....	32	1.39	5.3	9.56	306	13.30
Barley.....	298	do.....	2,239	7.50	40.0	.92	2,068	6.93
Beets, sugar.....	5,264	Ton.....	42,106	8.00	15.7	6.08	255,826	48.61
Red-clover hay.....	17	do.....	32	1.88	2.5	11.00	352	20.65
Red-clover seed.....	8	Bushel.....	30	3.75	6.0	9.13	274	34.25
Sweet-clover seed.....	16	do.....	46	2.90	11.0	9.00	414	26.00
Corn.....	174	do.....	1,732	9.97	50.0	.86	1,496	8.62
Corn fodder.....	41	Ton.....	78	1.88	3.1	5.33	416	10.02
Cucumbers.....	12	do.....	.....	.....	.....	.....	394	33.50
Garden.....	152	do.....	.....	.....	.....	.....	9,533	62.82
Miscellaneous hay.....	300	Ton.....	299	1.00	2.0	14.74	4,406	14.69
Oats.....	2,628	Bushel.....	37,795	14.38	95.4	.63	23,651	9.00
Pasture.....	1,393	do.....	.....	.....	.....	.....	8,867	6.36
Potatoes.....	54	Bushel.....	5,155	95.02	800.0	1.14	5,889	108.55
Wheat.....	2,624	do.....	31,161	11.87	50.0	1.46	45,529	17.35
Miscellaneous.....	155	do.....	.....	.....	.....	.....	387	.....
Total.....	18,581	.....	.....	.....	.....	.....	489,071	.....
Average.....	.....	.....	.....	.....	.....	.....	.....	26.32

LIVE STOCK.

The number and value of live stock owned on the project on January 1 and on December 31, 1916, according to the United States Reclamation Service, are shown in Table III.

TABLE III.—*Live stock on the Huntley Reclamation Project in 1916.*

Item.	Inventory, Jan. 1.			Inventory, Dec. 31.			Increased total value.
	Number.	Average value.	Total value.	Number.	Average value.	Total value.	
Horses.....	1,961	\$117.00	\$230,175	1,961	\$124.00	\$243,095	\$12,920
Mules.....	53	135.00	7,160	58	138.00	7,990	830
Cattle:							
Beef.....	1,809	47.00	156,023	1,982	42.00	82,337	33,195
Dairy.....	1,507			1,753	64.00	111,881	
Sheep.....	6,198	4.71	29,199	3,729	5.80	21,578	—7,621
Hogs.....	4,866	5.51	26,882	2,791	8.00	22,328	—4,494
Fowls.....	18,758	.50	9,379	16,418	.54	8,900	—479
Bees, hives.....	288	5.09	1,467	282	3.33	939	—528
Total.....	.....	.....	460,285	.....	.....	499,048	38,763

The high prices for feeds and for live stock during the latter part of the year 1916 resulted in reductions in the numbers of sheep and

hogs. The principal live-stock development during the year was made in the dairy industry, in which interest was stimulated by unusually high prices for dairy products. There were substantial improvements in dairying methods during the year. A number of dairy cows were brought to the project, and a cooperative cheese factory was established at the town of Ballantine.

EXPERIMENTS WITH IRRIGATED FIELD CROPS.

The principal purpose of the Huntley Experiment Farm is to investigate problems associated with the establishment of the major agricultural industries of the project and the irrigated sections in the adjacent territory. These industries include chiefly sugar beets, live stock, and live-stock products. The successful establishment of these industries requires the development of satisfactory cropping systems and efficient methods of crop utilization. Since the establishment of the Huntley farm an increasing amount of attention has been given each year to these problems. A summary of the more important developments in the experiments with irrigated crops in 1916 is given in this report.

CROP ROTATIONS.¹

The experimental work with crop rotations under irrigation was begun in 1912. Field K, containing 70 quarter-acre plats, is used for this work. In 1916 a series of new rotations was started on 27 quarter-acre plats in field L-IV. The crops included in these rotations are alfalfa, sugar beets, potatoes, oats, corn, wheat, and flax. Five 6-year, four 4-year, five 3-year, and eleven 2-year rotations are used to determine the value of the various crop sequences. Fourteen plats are devoted to the continuous production of the above-named crops on the same land each year, so that a comparison can be made between the effect of continuous cropping and that of crop rotation. Standard varieties of these crops, which are well adapted to the region, are used throughout the experiment.

The chief purpose of these rotation experiments is to determine quantitatively which of the crop sequences are the most favorable for the production of the various crops and what is the value of manuring. It is generally believed that a rotation of crops and the use of farm manure are beneficial, but there is very little definite knowledge as to just how beneficial they are; or, in other words, whether crop rotation or manuring is really worth while on these new irrigated lands. It is believed that these rotation experiments may give some definite information on these points.

¹ The irrigated-crop rotation experiments are under the immediate supervision of Mr. Edward G. Noble, assistant, who prepared the report here made.

Crop yields.—With the season of 1916 the experiment completes its fifth year. It is still too early to draw any definite conclusions from it. The 6-year rotations have not yet completed their first cycle, and soil variation still remains an important factor. It is, nevertheless, possible to see in the results secured in 1916 some indications which may be useful to those engaged in crop production under con-

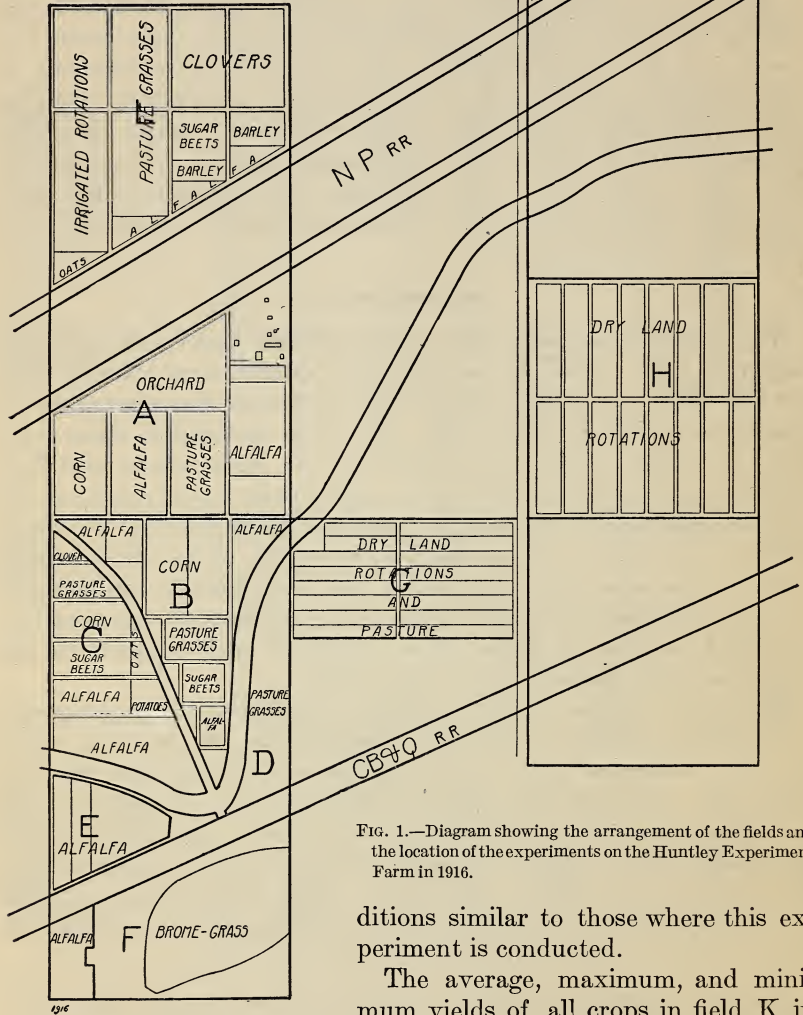


FIG. 1.—Diagram showing the arrangement of the fields and the location of the experiments on the Huntley Experiment Farm in 1916.

ditions similar to those where this experiment is conducted.

The average, maximum, and minimum yields of all crops in field K in 1916, together with the average of the same crops grown in 1913, 1914, and 1915, are given in Table IV.

TABLE IV.—Average, maximum, and minimum yields of all crops in field K (irrigated rotations), Huntley Experiment Farm, in 1916, and average of the same crops in 1913, 1914, and 1915.

Crop.	Variety.	Number of plats.	Unit of yield.	Yield per acre.					
				1916			Average.		
				Maximum.	Minimum.	Average.	1915	1914	1913
Alfalfa:									
First year.....	Montana.....	6	Ton.....	2.37	1.71	2.07	2.34	2.22	2.20
Second year.....	do.....	6	do.....	5.83	4.75	5.26	7.11	5.40	5.85
Third year.....	do.....	2	do.....	6.60	5.62	6.26	7.00	5.26	5.35
Continuously cropped.	do.....	4	do.....	6.21	3.86	4.98	4.72	4.62	4.51
Sugar beets.....	Kleinwanzlebener.	14	do.....	17.93	5.86	11.17	9.58	11.16	13.08
Potatoes.....	Mills Prize ¹	13	BusheL.	401.7	45.3	240.3	301.8	167.8	212.7
Oats.....	Swedish Select..	15	do.....	104.8	45.5	78.2	79.3	89.8	84.2
Wheat.....	Pringle Champion. ²	5	do.....	32.7	21.7	26.4	32.3	32.7	27.2
Corn.....	Northwestern Dent.	4	do.....	41.8	31.5	36.3	36.9	42.9	42.0
Flax.....	Minnesota No.25	2	do.....	27.9	7.5	17.7	21.3	18.6	21.7

¹ Rural New Yorker variety in 1913 and 1914.

² Locally known as Pringle Champion.

Table IV shows a wide difference between the highest and lowest yields obtained from the different plats. In most cases the maximum yield was more than twice the minimum. Each crop was planted on the various plats at the same time, the same variety of seed was used on all plats, and the cultural treatment was the same, so that the differences in yield must be due to differences in the plats. These differences between the plats on which the same crop is planted may be due in part to soil variation and in part to the effect of the preceding crop, or, in certain cases, to manuring. It is impossible to give an exact statement regarding soil variation. During the first years of the rotation experiment soil variation is doubtless an important factor, but as time goes on it will be possible to analyze the results in such a way as to reduce this factor to very small proportions.

Table V shows the yields of oats, potatoes, and sugar beets for each rotation in field K in 1916, with the preceding crop shown in each case. The yields of each crop are arranged in their order from the highest to the lowest. An inspection of this table will readily show which of the preceding treatments gave the best results in 1916. It should be kept in mind that all of the plats are probably not on equally good soil and that these results are the results of but one season.

TABLE V.—*Yields of oats, potatoes, and beets, with preceding crops in the irrigated rotation experiments at the Huntley Experiment Farm in 1916.*

[Beets-manured indicates manure applied to plat immediately after beets have been harvested; oats-rye indicates oats followed by rye seeded in the oat stubble in the fall and plowed under the following spring; oats-manured indicates oats with manure applied to the stubble in the fall and plowed under for the succeeding crop; hogged indicates crop harvested by hogs.]

Oats.			Potatoes.			Beets.		
Preceding crops. ¹	Rotation No.	Yield.	Preceding crops. ¹	Rotation No.	Yield.	Preceding crops. ¹	Rotation No.	Yield
Alfalfa.....	61	<i>Bush.</i> 104.8	Alfalfa.....	61	<i>Bush.</i> 401.7	Potatoes.....	21	<i>T ns</i> 17.43
Do.....			Do.....			Beets-manured.....		
Potatoes.....	60	101.6	Do.....	25	324.0	Potatoes.....	61	15.56
Do.....			Oats-manured.....			Alfalfa.....		
Potatoes.....	22	94.5	Potatoes.....	21	293.6	Potatoes.....	20	15.02
Beets.....			Oats-manured.....			Potatoes.....		
Oats.....	42	91.4	Beets-manured.....	60	292.0	Beets.....	67	13.60
Beets.....			Potatoes.....			Potatoes.....		
Do.....	25	87.3	Alfalfa.....	40	246.7	Alfalfa-hogged.....	23	11.98
Alfalfa.....			Do.....			Corn-hogged.....		
Potatoes.....	44	83.5	Corn.....	26	278.8	Flax.....	42	11.39
Beets-manured.....			Potatoes.....			Oats-manured.....		
Oats.....	23	82.3	Corn.....	40	246.7	Beets.....	2	11.19
Potatoes.....			Beets.....			Oats-manured.....		
Oats-manured.....	31	77.3	Alfalfa.....	24	236.2	Alfalfa.....	22	11.14
Beets.....			Do.....			Do.....		
Potatoes.....	24	72.1	Oats.....	20	227.7	Do.....	40	10.38
Do.....			Beets.....			Oats.....		
Oats.....	16	67.8	Potatoes.....	30	224.5	Beets.....	31	10.02
Potatoes.....			Beets.....			Potatoes.....		
Corn.....	32	61.5	Oats-manured.....	4	175.3	Oats-manured.....	18	8.24
Do.....			Potatoes.....			Wheat.....		
Oats.....	30	46.9	Do.....	44	166.0	Beets.....	60	7.40
Beets.....			Oats.....			Alfalfa.....		
Potatoes.....	27	45.5	Alfalfa.....	27	45.3	Potatoes.....	30	6.73
Do.....			Do.....			Beets.....		
Oats-rye.....			Oats-rye.....			Do.....	32	5.86
Potatoes.....			Potatoes.....			Potatoes.....		
Average of all plats.....		78.2	Oats-rye.....		240.3	Corn.....		
						Oats.....		

¹ In each instance the first-named crop was grown in 1913, the second in 1914, and the third in 1915.

The season of 1916 was fairly favorable for the production of alfalfa. The average of all plats, including spring-seeded, second-year, and continuously-cropped alfalfa, was 4.02 tons per acre. In 1915 the average yield was 5.04 tons and in 1914 it was 4.24 tons.

Sugar beets grown in the rotations yielded 1.59 tons more per acre in 1916 than in 1915. The average percentage of sugar, however, was much lower, it being 15.5 per cent in 1916 and 17.7 per cent in 1915. Beets grown on manured oat-stubble land averaged 12.52 tons per acre, whereas the average yield of beets after oats without manure was 8.5 tons. The maximum yield of sugar beets was obtained in a two-year rotation of beets, manured, followed by potatoes. A view

of the plats in this rotation is shown in figure 2. Beets grown for the fifth successive year on the same plat averaged 11.19 tons per acre in 1916, or slightly above the average for all plats in that year.

The importance of growing potatoes in a rotation which includes alfalfa or manure is indicated by the results shown in Table V. The average yield of potatoes in all rotations was 240.3 bushels per acre in 1916. In 1915 the average was 301.8 bushels.

Oat yields in 1916 were affected by the warm and dry weather. A shorter growth of straw, a heavier weight per bushel, a narrower ratio of grain to straw, a smaller percentage of oats lodged, and a lower average yield per acre were recorded in 1916 as compared with



FIG. 2.—Sugar beets grown in a 2-year rotation with potatoes at the Huntley Experiment Farm in 1916. Manure is applied to the beet ground as soon as the crop has been removed. This plat yielded at the rate of 17.93 tons of beets per acre in 1916.

the previous season. Oats following oats or wheat yielded much less than when grown after alfalfa or a cultivated crop.

The maximum yield of wheat was secured in a two-year rotation with sugar beets. Wheat grown on the same plat for five years yielded 21.7 bushels per acre. On an adjoining plat, also seeded to wheat for five years but having the straw returned each fall and plowed under, the yield was 24.8 bushels per acre.

The average yield of corn in 1916 was 36.3 bushels per acre. This was 0.6 bushel below the average in 1915. The maximum yield was secured in a two-year rotation with potatoes; the minimum in a two-year rotation in which corn follows oats.

Flax grown on land on which alfalfa was pastured by hogs in 1914 and on which the corn was hogged off in 1915 yielded 27.9 bushels per acre in 1916. A plat continuously cropped to flax for five years

produced 7.5 bushels per acre. The advantage of growing flax in a rotation is clearly shown by the fact that the yield obtained has been at least double that of a continuously cropped plat during each of the past four seasons.

Pasturing alfalfa with hogs.—Rotation 67, a 6-year rotation in field K, consists of corn, flax, sugar beets, and three years of alfalfa. The third-year alfalfa and the corn are harvested by hogs. The object of this work is to determine the value of hogs as a means of disposing of these crops. The alfalfa-pasturing experiment is divided into two periods—May to July, or the spring period, and July to September, or the summer period. Fall pigs are used for the first period and spring pigs in the second. In each case the pigs are pastured at the rate of 2,000 to 2,500 pounds per acre. The quarter-acre plat is divided into two equal areas and the hogs are pastured alternately on these areas for periods of 9 to 12 days, depending upon weather conditions and the growth of the pasture. This arrangement allows for a more uniform growth of the alfalfa and convenience in irrigating. In addition to the pasture, the hogs are given a supplementary ration of 2 pounds of corn a day per hundred pounds of live weight.

On May 1, 1916, five high-grade Duroc-Jersey shotes were placed on the pasture. The total weight of the five hogs was 524 pounds, or an equivalent of 2,096 pounds per acre. The alfalfa during the entire spring period kept the hogs well supplied with pasture. The pigs were taken off the pasture on July 15. On the same day eight grade Duroc-Jersey shotes were placed on the plat. A view of these shotes is shown in figure 3. These pigs, which had a total initial weight of 356 pounds, remained on the pasture until September 23.

During the two periods 758 pounds of pork were produced. The corn consumed during the entire season amounted to 1,750 pounds. Estimating the value of pork at 7 cents per pound, the gross return from the plat was \$53.06. The cost of the corn fed, estimated at \$1.25 per hundred pounds, was \$21.88. This leaves a return from the alfalfa crop of \$31.18 for the plat, or \$124.72 per acre. In 1915 the return per acre, calculated in the same manner, was \$75.88, and in 1914 it was \$76.88. The average yield of third-year alfalfa in other rotations was 6.26 tons per acre. Assuming that this plat would have produced 6.26 tons per acre, the return of \$124.72 is equivalent to \$19.92 per ton for the hay crop which was consumed by the hogs. These results, together with those secured in 1913, 1914, and 1915, indicate that the possibilities of pasturing alfalfa with hogs should receive the careful consideration of farmers on the Huntley project.

Hogging corn.—Four of the pigs used in the second period of the alfalfa-pasturing experiment in rotation 67 were transferred to the corn plat in the same rotation on September 23. Twenty days were

required for the hogs to harvest the corn. The estimated yield of this plat was 15 bushels, or 60 bushels per acre. During the 20 days the hogs gained 168 pounds, or an average daily gain of 2.1 pounds per hog. Valuing pork at 7 cents per pound, the hogs returned \$11.76 for the quarter acre, or 79 cents per bushel for the corn consumed. Five pounds of grain were required to make 1 pound of gain. In a similar experiment conducted in 1915, the hogs consumed 4.5 pounds of corn per pound of gain, and in 1914 they consumed 3.2 pounds.

Hogging off corn and rape.—The two corn plats in rotation 69, field L-IV, are hogged off. In 1916 Dwarf Essex rape was seeded broadcast between the corn rows on both plats on August 1. On account of the late planting and warm, dry weather the rape made but



FIG. 3.—Spring pigs on alfalfa pasture and 2 per cent corn at the Huntley Experiment Farm in 1916. The returns on this quarter-acre plat were estimated as equivalent to \$124.72 per acre or \$19.92 per ton of alfalfa hay.

little growth up to the time the hogs were turned into the corn. The supply of succulent feed for hogs in the form of rape, therefore, was of little consequence. Four of the spring pigs used in the second period of the alfalfa-pasturing experiment in rotation 67 were put on the plats of corn in field L-IV on September 23. These two plats were fenced in one inclosure. Thirty-eight days were required to clean up the plats. During this time 293 pounds of pork were produced from the half acre of corn and rape. The estimated yield of corn was 50.77 bushels per acre, or 25.38 bushels for the plat. Valuing pork at 7 cents per pound, the hogs returned \$20.51 for the half acre of corn, or 81 cents per bushel. On the basis of the estimated yield, 4.85 pounds of corn were required to make 1 pound of gain.

IRRIGATED PASTURES.

Since 1911 experiments have been conducted with pasture grasses to determine what mixtures are suited to the local conditions and to find satisfactory methods of getting pastures established. The work at first was devoted to preliminary tests of a large number of grasses, both separately and in mixtures, and later to methods of seeding and to tests of various mixtures of those grasses which had been found to be the most promising. Since 1914, carrying-capacity tests have been made in a limited way on some of the plats that were seeded in 1911 and 1913. In 1916 increased attention was given to tests of methods of seeding, in which three different mixtures were used.

Establishing pastures.—In 1916 an experiment was conducted in duplicate on 24 quarter-acre plats in field L-III in which four methods of seeding were used with each of three pasture mixtures, as follows: *a*, Spring seeded, with a nurse crop of wheat cut for grain; *b*, spring seeded, with a nurse crop of wheat cut for hay; *c*, spring seeded, without a nurse crop; and *d*, late summer seeded, in wheat stubble. The composition of the three mixtures and the rates of seeding are shown in Table VI.

TABLE VI.—*Pasture mixtures and rates of seeding in a method-of-seeding test at the Huntley Experiment Farm in 1916.*

Pasture mixture.	Rate per acre of seeding (pounds).		
	Mixture No. 1.	Mixture No. 2.	Mixture No. 3.
Awnless brome-grass.....	2	2	None.
Orchard grass.....	5	5	5
Tall fescue.....	3	3	3
Perennial rye-grass.....	3	3	None.
Kentucky bluegrass.....	4	4	4
White clover.....	2	None.	2
Alsike clover.....	2	do.	2
Total.....	21	17	16

The grass seed was sown in a mixture through the grain hopper of an ordinary grain drill, while the clover was planted at the same time through the alfalfa hopper. The spring seeding of both the grain and grasses was done on April 17, which was about as early as the ground could be prepared. The late summer seeding of grasses was done on August 24, when the seed was planted in the grain stubble with no seed-bed preparation after the grain was removed. Pringle Champlain wheat was used as a nurse crop.

In all cases a good stand of the grasses was secured, and there appeared to be but little difference between the stand where the nurse crop was cut for hay and where it was cut for grain. The plats seeded without a nurse crop were clipped three times during the fore

part of the season, in order to check weed growth, and were in good condition for pasturing by August 20. A crop of hay was harvested from these plats on September 21.

All the nurse-crop plats were given two irrigations before the nurse crop was harvested. The plats on which the crop was cut for hay were given two more irrigations after the wheat hay was removed. Where the nurse crop was cut for grain the plats were irrigated once after the grain crop was removed. The late summer-seeded plats were irrigated immediately after seeding and again three weeks later. Owing to the unusually dry weather that prevailed during the growing season, more irrigation was necessary than would be required in an ordinary season. The yields of wheat, wheat hay, and grass hay in this test are given in Table VII.

TABLE VII.—*Yields of wheat, wheat hay, and grass hay in a method-of-seeding test in field L-III at the Huntley Experiment Farm in 1916.*

Field L-III.	Method of seeding. ¹	Mixture No. ¹	Yield per acre. ²		
			Grain.	Wheat hay.	Grass hay.
			Bushels.	Tons.	Tons.
Plat No. 1.....	a.....	1		1.97	
Plat No. 2.....	b.....	1	39.0		
Plat No. 3.....	c.....	1			0.74
Plat No. 4.....	d.....	1	34.9		
Plat No. 5.....	a.....	2		1.97	
Plat No. 6.....	b.....	2	40.7		
Plat No. 7.....	c.....	2			.16
Plat No. 8.....	d.....	2	40.5		
Plat No. 9.....	a.....	3		1.97	
Plat No. 10.....	b.....	3	38.1		
Plat No. 11.....	c.....	3			1.10
Plat No. 12.....	d.....	3	38.7		
Plat No. 13.....	a.....	1		2.57	
Plat No. 14.....	b.....	1	39.7		
Plat No. 15.....	c.....	1			.96
Plat No. 16.....	d.....	1	37.7		
Plat No. 17.....	a.....	2		1.78	
Plat No. 18.....	b.....	2	32.4		
Plat No. 19.....	c.....	2			.29
Plat No. 20.....	d.....	2	29.5		
Plat No. 21.....	a.....	3		1.34	
Plat No. 22.....	b.....	3	29.9		
Plat No. 23.....	c.....	3			.25
Plat No. 24.....	d.....	3	28.3		

¹ The methods of seeding are described on page 12, and the mixtures are specified in Table VI.

² Average yields per acre: 12 plats of wheat, 35 bushels; 6 plats of wheat hay, 1.93 tons; 2 plats of grass hay, mixture No. 1, 0.85 tons; 2 plats of grass hay, mixture No. 2, 0.22 tons; 2 plats of grass hay, mixture No. 3, 0.67 tons.

The results secured in this test and in a similar test conducted in 1915 show that it is possible to obtain a good stand of grasses with grain seeded as a nurse crop, provided care is used in applying irrigation at the proper time and the ground is not allowed to become dry after the grain crop is removed; or, in other words, by irrigating to meet the requirements of the grasses rather than those of the nurse crop. In 1916, on plats that were seeded in 1915 by the four methods described above, there was apparently but little difference in the

growth of the grasses seeded by different methods, although the grasses which had been seeded without a nurse crop produced slightly more growth early in the season.

Carrying capacity with cows.—A test of the carrying capacity of pastures that was conducted with cows in 1914 and 1915 was continued in 1916. In this test two grade Jersey cows were pastured during the season on three quarter-acre plats of mixed grasses. Two of these plats were seeded in 1913, one to a mixture of awnless brome-grass, orchard grass, meadow fescue, tall fescue, Italian rye-grass, Kentucky bluegrass, and tall oat-grass, and the other to the same mixture with the addition of alsike clover and white clover. The third plat in the test was planted in 1911 to a mixture of awnless brome-grass, orchard grass, redtop, and timothy. The first two plats were fenced in one inclosure and pastured alternately with the third plat. The cows were on the half-acre part of the pasture for periods of from 10 to 14 days and on the quarter acre from five to seven days each time. Each part of the pasture was irrigated when necessary, as soon as the cows were removed to the other part. The half-acre inclosure was irrigated eight times during the season and the quarter-acre inclosure seven times.

The pasture period extended from May 8 to October 1, or 146 days. During this time the cows were actually on pasture 138 days, as they were kept off during stormy weather a total of eight days to prevent injury to the pasture by trampling when the soil was wet. While the cows were off pasture, each was fed 25 pounds of alfalfa hay per day. From September 8 to the end of the pasture period they were each fed 20 pounds of alfalfa hay per day in addition to the pasture. This was the only supplemental feed given during the season. During the latter part of June and the fore part of July the quantity of feed produced on the pasture was more than enough for the two cows, and the half-acre part of the pasture was clipped on June 22. As was done in the previous two years, one-half of each part of the pasture was top-dressed with barnyard manure at the rate of about 10 loads per acre. The effect of this top-dressing was very apparent in the increased growth of the grasses during the season.

One of the cows in the test was nearly dry at the beginning of the test and was dry during July and August. She freshened September 6. The other cow was dry at the beginning of the test and freshened on May 25. The cows produced during the pasture season a total of 145 pounds of butter fat, which at the local market prices had a value of \$40.98. During the pasture period a total of 1,050 pounds of alfalfa hay was fed. After deducting the value of this hay at \$7 a ton, the cows gave a return of \$37.32 for the three-fourths acre of pasture. This is at the rate of \$49.76 per acre. In 1915 the returns from the same pasture were at the rate of \$48.20 per acre.

Grass preference test.—A preference test of individual grasses was conducted in field B-V in 1916. In 1915 the following grasses were seeded in triplicate plats each 6 by 70 feet in size: Brome-grass, orchard grass, meadow fescue, perennial rye-grass, Kentucky bluegrass, and tall fescue. There were also three plats of white clover. There was a good stand of all the grasses except Kentucky bluegrass. A crop of hay was harvested from these plats on June 28. The plats were fenced in one inclosure, and one cow was placed on the pasture on August 9. The cow showed a decided preference for white clover and brome-grass and grazed these plats rather closely before eating much from the others. Preference for the remainder of the grasses appeared to be in the following order: Meadow fescue, orchard grass, tall fescue, and perennial rye-grass. By September 1 very little of the perennial rye-grass was eaten, while all of the other grasses except tall fescue were grazed rather closely. Perennial rye-grass makes but poor growth during the second season after planting and is also affected somewhat by winterkilling, and since it is not readily eaten by stock it appears that it is not a desirable grass to include in a pasture mixture.

New pastures for young stock.—A first-year pasturing test was conducted in which a 2-year-old heifer was pastured during the season on two quarter-acre plats in field B-V that were planted to mixed grasses in 1915. The mixture used was the same as that given below for the sheep pasture. One of these plats was planted without a nurse crop and was pastured in the fall of 1915, while the other plat was planted with wheat as a nurse crop. The plats were fenced separately and the heifer pastured alternately on them. There appeared to be but little difference in the quantity of feed produced on either part of the pasture, and the heifer was pastured on each part about an equal number of days during the season. The pasture period extended from May 1 to September 25, a total of 148 days. No supplemental feed was given during this time and the supply of pasturage was sufficient at all times. During the pasture period the heifer gained 46 pounds.

Pasturing sheep.—A sheep-pasturing test was conducted in 1916 on two quarter-acre plats in field B-V. One of these plats was planted in April, 1915, to a mixture of awnless brome-grass, orchard grass, meadow fescue, tall fescue, perennial rye-grass, Kentucky bluegrass, and white clover. On this plat wheat was grown as a nurse crop. The other plat was planted on August 25, 1915, to the mixture just described, with the addition of alsike clover. A good stand was secured on both plats. On May 6, 1916, five ewes, averaging in weight 136 pounds, and their five lambs, with an average weight of 75 pounds, were placed on the pasture. The plats were fenced separately and pastured alternately in periods of from 5 to

10 days. A view of the sheep and pastures used is shown in figure 4. It was found that the supply of pasture produced was not adequate at all times to support this number of sheep, and a few irregularities occurred in the pasturing during the season. The sheep were removed to another pasture for a period of four days during the latter part of May and were placed in a feed lot for a period of 10 days from June 21 to June 30, when they were fed alfalfa hay at the rate of 84 pounds a day. On July 30 one ewe and her lamb were removed from the pasture, and from then to the end of the pasture season, September 18, only eight head were on the pasture. The half acre of pasture, therefore, carried five ewes and five lambs for a period



FIG. 4.—Five ewes and their lambs on irrigated pasture in field B-V at the Huntley Experiment Farm in 1916. One-half acre divided into two pastures supported five ewes and five lambs for 71 days and four ewes and four lambs for an additional period of 49 days.

of 71 days, not including the days they were fed in the feed lot, and four ewes and four lambs for an additional period of 49 days. During the season the lambs made a total gain of 127 pounds and the ewes were maintained in fairly good condition.

SUGAR BEETS.

Distance of thinning and planting.—A spacing test with sugar beets was conducted in field B-VI in 1916. The beets were seeded in rows, respectively 18 inches, 20 inches, and 24 inches apart. In each width of row the beets were thinned to 6, 9, 12, 15, and 18 inches apart in the row. Each plat contained four rows 181.5 feet long, and each distance of thinning in each width was tested in triplicate, so that

there was a total of 45 plats. The highest yield, which was at the rate of 15.4 tons per acre, was secured from 24-inch rows, in which the beets were thinned to 6 inches in the row, although the difference in yield in any case was perhaps not enough to be significant. The minimum yield, 13.26 tons per acre, was secured on the 18-inch rows thinned to 15 inches apart. Considering the distance of thinning regardless of the width of row, the highest yield was secured from beets thinned to 12 inches, while the 24-inch rows gave the highest yield, not considering the distance thinned. This test was also conducted in 1912 and 1914.

A summary of the results secured in this spacing test in the three years is given in Table VIII.

TABLE VIII.—Average yields and sugar content of beets in a distance-of-thinning and planting experiment at the Huntley Experiment Farm in 1912, 1914, and 1916.

Width of row.	Distance thinned.	Yield per acre (tons).				Sugar content (per cent).			
		1912	1914	1916	3-year average.	1912	1914	1916	3-year average. ¹
<i>Inches.</i>									
18 inches.....	6	17.4	17.08	14.03	16.17	19.5	16.7	17.5	17.9
Do.....	9	15.5	14.48	14.13	14.70	18.4	17.3	17.8	17.8
Do.....	12	17.8	15.84	15.28	16.31	18.6	16.7	17.8	17.7
Do.....	15	14.9	15.38	13.26	14.51	18.5	16.5	17.4	17.4
Do.....	18	14.6	15.84	14.16	14.87	19.1	16.4	17.7	17.7
Average.....		16.04	15.72	14.17	15.31	18.8	16.7	17.6	17.7
20 inches.....	6	15.4	15.36	13.98	14.91	19.2	16.3	17.9	17.8
Do.....	9	14.3	15.61	13.34	14.41	18.3	17.2	17.5	17.7
Do.....	12	16.1	16.71	13.69	15.50	19.2	16.1	17.5	17.6
Do.....	15	14.8	17.14	14.29	15.41	18.1	15.9	16.8	16.9
Do.....	18	15.1	17.70	14.10	15.63	18.8	15.6	17.2	17.2
Average.....		15.14	16.50	13.88	15.17	18.7	16.2	17.3	17.4
24 inches.....	6	16.2	18.68	15.40	16.76	19.7	16.0	17.3	17.7
Do.....	9	15.3	18.55	14.08	15.97	18.2	15.9	17.2	17.1
Do.....	12	14.1	17.82	14.57	15.49	19.0	16.0	17.1	17.3
Do.....	15	15.3	17.75	14.99	16.01	17.9	15.4	17.2	16.8
Do.....	18	15.9	17.44	14.79	16.04	18.6	16.4	16.4	17.1
Average.....		15.36	18.05	14.76	16.03	18.7	15.9	17.0	17.2

¹ Three-year average yield per acre of all plats thinned to—

6 inches.....	tons..	15.95
9 inches.....	do....	15.03
12 inches.....	do....	15.77
15 inches.....	do....	15.31
18 inches.....	do....	15.51

Table VIII indicates that the highest yielding combination of width of row and thinning was the 24-inch row thinned to 6 inches. The yield in this case was at the rate of 16.76 tons per acre. Considering the yield from the different widths of row, regardless of the distance of thinning, the highest was secured on the 24-inch rows. The 6-inch thinning, regardless of the width of row, gave the highest yield, and the 12-inch thinning gave the next highest. The differences in yield were but slight and were inconsistent. There appeared to

be a slight decrease in sugar content in the beets as the width of row and distance of thinning and size of beets produced were increased.

Root-lice control.—Sugar beets are often damaged seriously by invasions of the sugar-beet root louse. Invasions of this pest occur during the latter part of June or early in July, at which time the root lice migrate in large numbers to the beet fields from cottonwood trees along the river bottoms, where they are hatched out. If conditions are favorable at this time the lice enter the soil around the beets and increase rapidly in numbers.

The experiment conducted in 1914 and 1915 to determine means of controlling the sugar-beet root louse was continued during 1916. This experiment was conducted in cooperation with the biology department of the Montana Agricultural Experiment Station. The plan of the experiment provided in one case for irrigating earlier than is commonly practiced and keeping the soil well supplied with moisture at all times during the growing season, and especially during the migration period of the root louse, in order to keep the soil from cracking and thus to prevent the lice from becoming established in the soil around the beets. In another case the soil was allowed to become dry before the first irrigation was applied, and again during the latter part of August. In a third case, or check plat, irrigation was applied as it is usually done in ordinary farm practice.

In addition to nine tenth-acre plats used in this experiment in field C-IV in previous years, the experiment was duplicated on six quarter-acre plats in field L-IV. In both fields the "wet" plats were irrigated five times, while the check plats were irrigated three times and the "dry" plats twice during the season. As the precipitation was somewhat below normal during the growing season, it was possible to control fairly well the amount of moisture in the soil.

At the time of harvesting, each beet was examined to determine the amount of infestation, and samples for sugar analysis were taken on all plats, both of infested beets and beets not infested with root lice. The yields and other data relating to the test are given in Table IX. The yields in field C-IV are the average in each case of three plats, while in field L-II they are the average of two plats in each instance.

The results indicate that in field C-IV there was but a slight difference in yield on the plats that received three irrigations and those that received five irrigations, whereas the yield of the plats that received but two irrigations was about 2 tons less than either of the others. The amount of injurious infestation was much greater on the "dry" plats than on either of the others. In all cases the amount of sugar in the beets was less in the samples that were infested by root lice. In field L-II the yield was increased as the number of irrigations was increased. The amount of infestation was less in the

plats that were irrigated three times than in the plats that were irrigated twice, and still less in the plats that were irrigated five times. In this field also the amount of sugar in the beets was, without exception, less in the infested samples than in the uninfested samples. The results in field L-II are similar to those secured in field C-IV in 1914 and indicate that injury done to beets by infestation from root lice can be lessened to some extent by more frequent applications of irrigation water. Before definite recommendations can be made, however, it is desirable to continue the experiment for at least two more seasons.

TABLE IX.—*Yield, sugar content, and percentage of infestation in a sugar-beet root-louse control experiment at the Huntley Experiment Farm in 1916.*

Field.	Number of irrigations.	Yield per acre.	Sugar content (per cent).			Percentage of beets injuriously infested.
			Beets not infested.	Beets infested.	Average field sample.	
		<i>Tons.</i>				
C-IV.....	2	9.63	17.6	16.3	16.3	34.6
	3	11.70	18.2	16.6	17.6	9.5
	5	11.12	18.2	17.0	17.7	9.9
L-II.....	2	14.27	12.7	11.2	12.8	37.3
	3	17.18	12.2	10.6	12.7	25.9
	5	18.84	14.4	11.9	13.7	14.1

Siloing test.—To determine the loss in weight and the effect on sugar content of beets when siloed at harvest time, a siloing test was conducted with two lots of beets, one of about 10 tons and the other of about 12 tons. The siloing was done in the ordinary manner by placing the beets in long piles about 10 or 12 feet wide at the base and 6 feet high and covering with soil to a depth of 2 or 3 inches. Samples for dirt-tare determinations and for sugar analysis were taken both when the beets were placed in the silo and again when they were taken out. Data relating to this test are given in Table X.

TABLE X.—*Change in weight and in sugar content of siloed beets at the Huntley Experiment Farm in 1916.*

Silo.	Time in silo.	Weight (pounds).		Loss in weight.	Average sugar content.			
		Initial.	Final.		When placed in silo.		When taken out of silo.	
					Number of samples.	Sugar.	Number of samples.	Sugar.
No. 1.....	Days. 45	24,040	23,188	Per cent. 3.5	22	Per cent. 17.2	24	Per cent. 17.1
No. 2.....	22	21,330	20,191	5.3	56	17.4	21	17.6

The beets from both silos were taken out on December 1, and in both cases were slightly damaged, especially near the outside of the piles, as a result of severe freezing followed by warm weather after they were siloed. The light covering of soil which in ordinary seasons is considered ample did not this year afford sufficient protection.

The loss in weight was somewhat higher than in a similar test in 1915. The average loss from the two silos in 1915 was 2.5 per cent. In 1916 the sugar content remained practically the same, while in 1915 there was a decrease in one silo of 1.1 per cent and in the other of 0.5 per cent.

On the basis of the 1916 prices for beets (\$6.50 per ton for beets testing 17 per cent and under 17.5 per cent) in silo No. 1 there was a loss in value of 23 cents per ton, and in silo No. 2 a loss of 34 cents per ton due to loss in weight while the beets were in the silo, or an average loss of 28.5 cents per ton. Siloed beets were paid for in 1916 at the additional rate of \$1 per ton, so that in this case 71.5 cents per ton would be received for the work of siloing.

CLOVER.

Methods of planting.—An experiment in methods of planting clover was conducted on 24 quarter-acre plats in fields L-I and L-II. It is planned to use these plats later for experiments in seed production. Red clover, white clover, and alsike clover were used in this test.

Each species was planted on duplicate plats by each of the following methods: *a*, Spring seeded, with wheat as a nurse crop cut for hay; *b*, spring seeded, with wheat as a nurse crop cut for grain; *c*, spring seeded, without a nurse crop; and *d*, late summer seeded, in wheat stubble. The spring seeding of both wheat and the clovers was done on April 23. The seeding rate of each of the clovers was 10 pounds per acre and of the wheat 1 bushel per acre. Of the red clover a good stand was secured in the three methods of spring seeding, while of the white clover and alsike clover the stand was good only on the plats without a nurse crop. On the plats seeded to white clover and alsike clover with a nurse crop, only about a 50 per cent stand was secured, and these plats were reseeded at the rate of 5 pounds per acre on August 27. The seeding of clovers in wheat stubble was done on August 27, and in all cases a good stand was secured. These plats were irrigated immediately after planting and again on September 6.

All the plats seeded without a nurse crop were clipped twice in the fore part of the season to check weed growth, and from the red-clover and alsike-clover plats a crop of hay was harvested on September 21. The red-clover plats produced an average yield of 1.8 tons of hay per acre and the alsike clover a yield of 0.65 ton per acre. The average

yield of wheat on six plats on which the nurse crop was cut for grain was 40.6 bushels per acre. The average yield of wheat hay from six plats was 2.03 tons per acre.

ALFALFA.

Seed-production test.—A test of alfalfa seed production was conducted on 13 quarter-acre plats in field A-IV. This alfalfa was planted in 1912. Three methods in which different crops were left for seed were employed, as follows: (1) Clipping the alfalfa early, when about 8 or 10 inches high, leaving the second growth for seed; (2) harvesting the first crop for hay at the usual time, leaving the second crop for seed; and (3) leaving the first crop for seed.

The average yield of seed on the four plats that were clipped early was at the rate of 2.56 bushels per acre. The average yield of the three plats on which the second crop was left for seed was at the rate of 2.39 bushels per acre. The yield of the three plats on which the first crop was left for seed was at the rate of 3.44 bushels per acre.

BARLEY VARIETIES.

A test of six varieties of barley was conducted in duplicate on 12 ninth-acre plats in fields L-I and L-II. The varieties grown and the average yield of each are given in Table XI.

TABLE XI.—*Yields of barley in a variety test at the Huntley Experiment Farm in 1916.*

Variety.	Yield per acre.	Variety.	Yield per acre.
	<i>Bushels.</i>		<i>Bushels.</i>
Svanhals.....	45.5	Coast.....	35.2
Smyrna.....	45.5	Thorpe.....	32.1
Hanna.....	41.7	Mariout.....	31.1

Table XI shows that the Svanhals and Smyrna were the two highest yielding varieties, the yield being the same in both cases. This was the second grain crop on this land since the native sod was broken in 1914, which probably accounts for the rather low yield of all the varieties.

CORN.

Variety test.—A test of six varieties of corn was conducted in field C-III. The season was rather favorable for corn and the earlier varieties were fairly well matured before the date of the first killing frost, which occurred on September 13. The yield secured in this test and also the yields of some of the varieties that were grown in a similar test in 1914 and 1915 are shown in Table XII.

TABLE XII.—*Yields of corn in varietal tests at the Huntley Experiment Farm in 1914, 1915, and 1916.*

Variety.	Date of maturity.			Yield per acre.											
				Grain bushels, at 72 pounds.				Stover (pounds).				Total grain and stover (pounds).			
	1914	1915 ¹	1916	1914	1915	1916	Average.	1914	1915	1916	Average.	1914	1915	1916	Average.
U. S. Selection 133...	Sept. 28	Oct. 15	Sept. 15	20.50	25.4	24.2	42.3	48.9	4,928	4,791	4,653	4,791	8,209	8,693	7,816
Marten White Dent...	25	Oct. 10	10	25.57	14.5	8.31	6.44	8.4	4,591	4,166	4,653	4,470	8,708	7,464	6,928
Northwestern Dent...	15	Oct. 5	5	10.48	14.0	5.41	8.43	4.3	3,720	2,376	3,149	3,081	7,190	5,292	6,159
Minnesota No. 23...	10	Sept. 30	30	10.34	6.35	3.38	7.36	2.2	3,872	2,525	2,853	2,588	4,778	5,067	5,643
Minnesota No. 13...	21	Oct. 15	15	15.39	2.37	6.33	4.36	7.7	2,579	2,908	2,577	2,688	5,582	5,615	4,995
Calico.....				25			25.9				5,579				7,470

¹ In 1915 the date of maturity of the varieties that were not matured when frost occurred was estimated.

Table XII shows that the U. S. Selection 133 gave the highest average yield for the three years and that Marten White Dent gave the next highest yield. These varieties, however, are rather late in maturing and in the ordinary season will probably not mature before frost. Of the earlier maturing varieties the Northwestern Dent gave the highest yield and was the earliest to mature. The results so far secured lead to the belief that the Northwestern Dent is the most dependable variety which has been tested.

Varieties for silage.—A test of six varieties of corn for silage was conducted in duplicate in field A-IV on 12 quarter-acre plats. It was planned to have a silo constructed to handle the crop, but since this was not done it was possible only to estimate the silage yields by harvesting one row from each plat. As there were two plats of each variety, the average yield in each case was secured from two rows, amounting to one twenty-second of an acre. The yields obtained are given in Table XIII.

TABLE XIII.—*Yields of silage corn in field A-IV at the Huntley Experiment Farm in 1916.*

Variety.	Yield per acre.	Variety.	Yield per acre.
	<i>Tons.</i>		<i>Tons.</i>
Australian Flint.....	14.49	Local Yellow Dent.....	9.39
Marten White Dent.....	13.31	Minnesota No. 13.....	9.13
U. S. Selection 133.....	11.66	Northwestern Dent.....	8.69

The varieties Northwestern Dent, Minnesota No. 13, and Local Yellow Dent were matured enough for silage by September 10. U. S. Selection 133 and Marten White Dent were beginning to dent, and Australian Flint was in the soft-dough stage by the date of the first frost, which occurred on September 13. While the highest yields were secured from the later maturing varieties, some of them were not matured enough to make the best silage. The one year's

results indicate that only in exceptionally favorable seasons would the later maturing varieties reach the proper stage of maturity.

FERTILIZER TEST.

A test of acid phosphate as a fertilizer has been conducted every year since 1913 on 12 twentieth-acre plats in field B-VII. The fertilizer is applied each year to the same plats at the respective rates of 300, 500, and 700 pounds per acre. A fourth group of three plats receives no fertilizer. Three grain crops—wheat, oats, and barley—were grown in the test in 1913. In 1914 and 1915 all the plats were planted to oats. Alfalfa was seeded on all the plats in the spring of 1916. This alfalfa was clipped twice early in the season in order to check weed growth. A crop of hay was harvested from these plats on September 21. The average yield of hay was at the rate of 1.55 tons per acre and there was no significant difference in yield that could be attributed to the effect of the fertilizer. These results are similar to those obtained with the other crops in this experiment in previous years.

FRUIT TREES.

Experiments were started in 1911 with about 100 varieties of apples, plums, and sour cherries in the orchard in field A. Many of these trees, especially apples, have been lost each season by winterkilling, and several of the varieties have been replaced since the first season by trees of varieties that appeared from the first trial to be most hardy.

The winter of 1915-16 was unusually severe on the apple trees, and many of them that were 3 or 4 years old were lost by winterkilling. Other trees that were not entirely killed were so badly injured that they did not start to leaf until late in spring and consequently made but little growth during the season. Of a total of 150 apple trees alive in the fall of 1915, 47, or nearly one-third, were lost from winterkilling. The varieties that withstood the winter best were Oldenburg (*Duchess of Oldenburg*), Fameuse, Gideon, Livland Raspberry, Northwestern (*Northwestern Greening*), University, Wolf River, Wealthy, Wagener, Yellow Transparent, and Hibernial. Most of the crab-apple trees came through the winter in fairly good condition. Of a total of 31 trees alive in the fall of 1915 only 2 were lost. Two sour-cherry trees out of a total of 22 and 5 plums out of a total of 54 were winterkilled. As a result of a late spring frost, which was severe enough to kill the fruit buds, none of the trees produced fruit in 1916.

ORNAMENTAL TREES AND SHRUBS.

Plantings were made in 1911 and 1913 of a number of trees and shrubs on the experiment-farm grounds. The results secured with these plantings have given some indication as to the plants that are hardy and suited to conditions on the Huntley project.

For quick growth the poplars are perhaps the best. Norway and Carolina poplars in these plantings have reached a height of 20 to 25 feet in five years. For windbreak purposes, poplars with alternate rows of green ash and white elm, with rows of the Russian olive and the Siberian pea tree on the outside, will give good results. These should be planted in rows 6 to 8 feet apart with the plants 4 to 6 feet in the rows. For group plantings poplars can be used and alternated with green ash, box elder, and white elm, with the Russian olive and the Siberian pea tree and smaller shrubs on the outside. In all cases close planting will give the quickest results and after the first few years will shade the ground sufficiently to check weed growth and make cultivation unnecessary.

Of the ornamental shrubs that have been planted at the experiment farm, the following appear to be suited to conditions: Yellow flowering currant, Siberian dogwood, *Physocarpus opulifolius*, Van Houtte's spirea, lilac, common snowball, purple barberry, common barberry, Japanese barberry, and buckthorn. The Russian olive has done especially well and is suitable both for separate planting and for hedges. It is quick growing and will make a dense hedge in three or four seasons after planting seed. A view of the plantings of trees and shrubs on the experiment-farm grounds is shown in figure 5.

EXPERIMENTS ON THE WORDEN TRACT.

Experiments were started in 1910 on a tract of heavy alkali soil near the Worden town site on the Huntley project. These experiments during the first three years were devoted to the trial of different methods of reducing the excessive amount of salt and improving the physical condition of the soil. Fairly good crops were produced on this land in 1913, indicating that these soil treatments were effective. The land later was seriously affected by seepage, as a result of the rapid rise of the ground water under this area in 1914 and 1915. This seepage condition was especially bad in the western part of the field. The construction of a drain during the summer of 1915 relieved this condition, and the ground water was lowered to a depth below 5 feet. Determinations made each year of the amount of alkali salts indicated that these were present in increasing amounts after 1913 in the first 4 feet of soil as a result of the rise of the ground water. The effect of this increase in alkali was very apparent in the poor growth in 1916 of alfalfa that was planted on this land in 1914 and 1915. The eastern part of this tract was less seriously affected by seepage, and alfalfa that was planted on this land in 1914 gave fairly good results in 1915 and 1916.

A test of methods of producing alfalfa seed was conducted in this field in 1916. In this test three methods were used, as follows: (1) First crop clipped early when about 8 or 10 inches high and the

second growth left for seed; (2) first crop harvested for hay at the usual time and second crop left for seed; and (3) first crop left for seed. The plats under methods 1 and 3 gave promise at first of producing fair quantities of seed, but they were damaged later by an invasion of grasshoppers and produced only 66 and 48 pounds of seed, respectively. The plat under method 2 gave a yield of 1.38 tons of hay in the first crop. Only a small number of seeds formed on the second growth, so this crop was also cut for hay, which yielded at the rate of 0.91 ton per acre. The total yield for the two crops

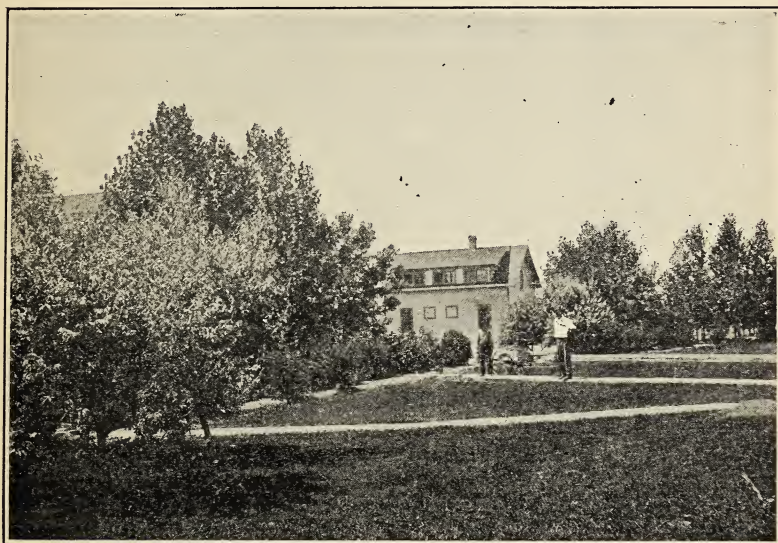


FIG. 5.—Part of the grounds of the Huntley Experiment Farm in 1916. The trees and shrubs were planted in 1911. The larger trees in the background are Carolina poplars and box elders.

was 2.28 tons per acre. In a test of the first crop for seed with some alfalfa on the west part of the field, three plats yielded seed at the average rate of 3.15 bushels per acre.

A quarter-acre plat of sweet clover in this field yielded at the rate of 4.53 bushels of seed per acre. This crop makes a very heavy growth on this soil when once established, and from the results secured in 1915 and 1916 it appears to be one of the best crops for this heavy land, both as a seed crop and for hay and pasture.

Approved:

WM. A. TAYLOR,
Chief of Bureau.

MAY 3, 1917.

